70/80 GHz for 5G Backhaul

March 2020

Agenda

- 5G Network Trends and Densification
- E-Band Technology Evolution
- Proposed Rule Change to Permit Smaller Antennas: Antenna Gain
- Additional Rule Change (Desired but Not Required): Improve Registration and Certification
- Conclusions and Next Steps

5G Network Trends and Densification

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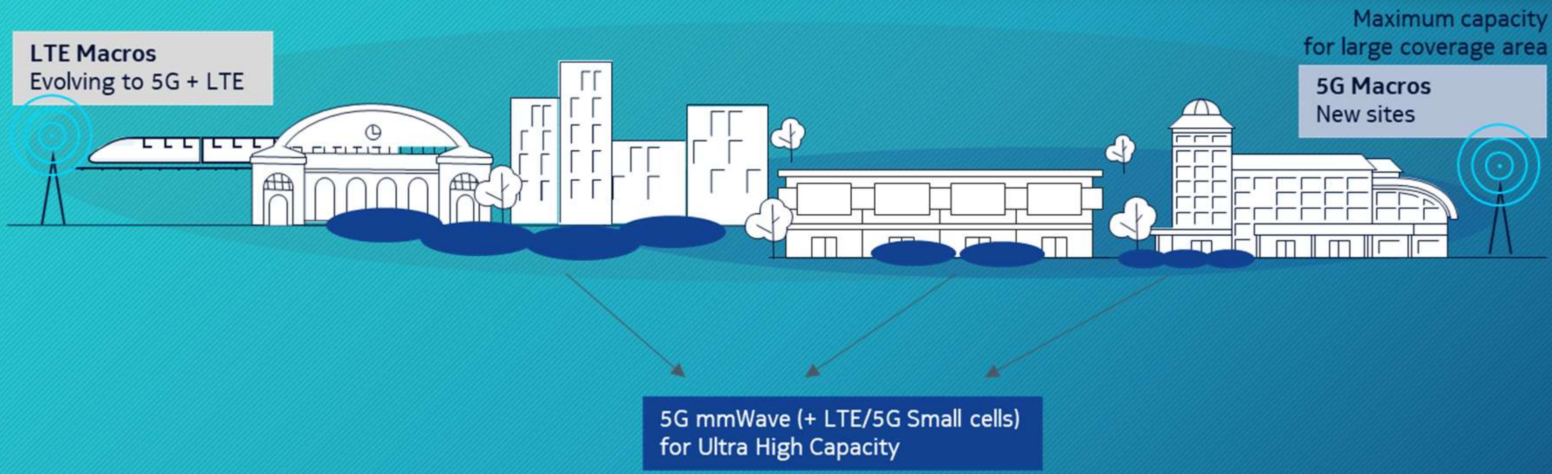
5G Network Trends and Densification

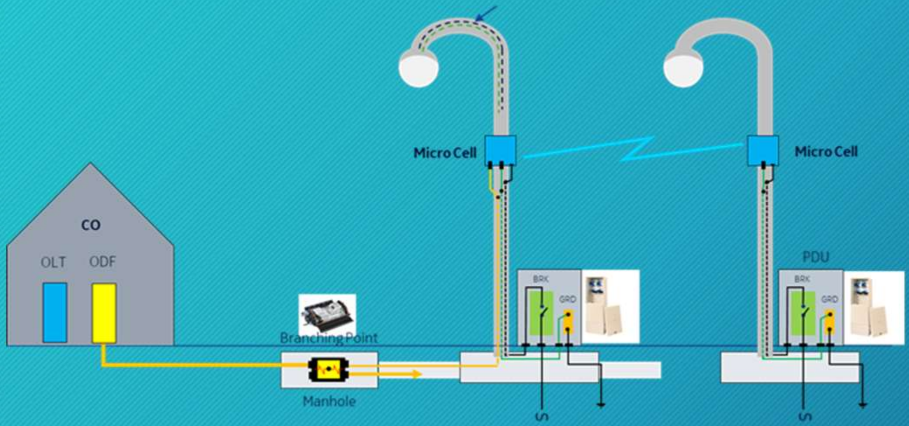


Focus here is densification provided by 5G mmWave networks :

→ need for reliable backhaul solutions on top of fiber

→ PtP E-band powerful solution, but rule change necessary to fully enable it along with corresponding 5G use cases

5G Network Trends and Densification



Wireless connectivity/transport as **enabler for 5G:**

- fiber might not available in the deployment area
- fiber PoP is just one or few hundred meters away from the radio access point

E-band Technology Evolution

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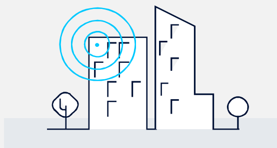
E-band Technology evolution

E-band (and future evolution to D-band) are the only viable solutions to enable true 5G densification

Suburban

- Up to 10 Gbps for 5G backhaul/midhaul up to 5 miles
- Carrier aggregation microwave + E-band

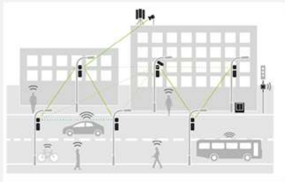
2ft dual band antenna



Urban

- 10-20 Gbps for 5G backhaul/midhaul up to 2 miles
- E-band only

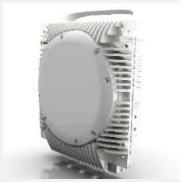
1ft/2ft antenna (43-50dBi)



Dense urban

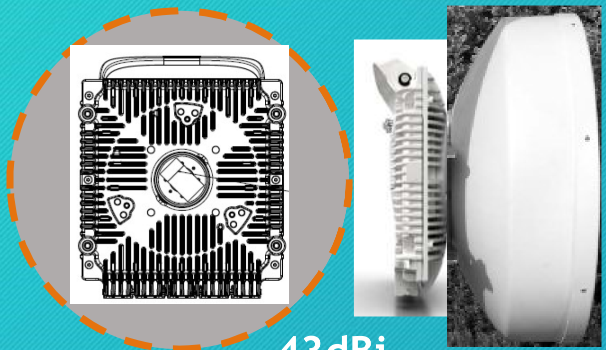
- 10/20 Gbps for 5G backhaul/midhaul/FH short distance @street level
- E-band only w/ High integration

38dBi embedded antenna



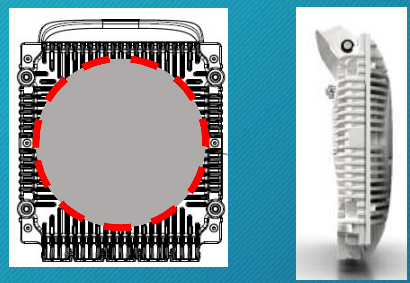
E-band flexibility addressing several use cases and 5G introduction (needed today)

E-band technology evolution
Antenna



43dBi

VS



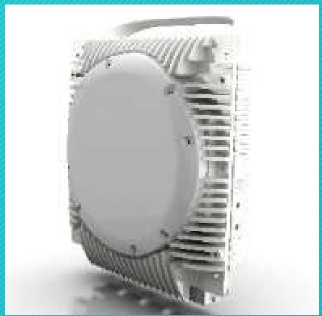
38dBi

- Traditional parabolic antenna
- Very thick
- 43dBi
- 1 foot

- Innovative embedded antenna
- Minimal visual impact
- 38dBi
- 0.5 foot

Street-level mounting structures tend to sway. Smaller antennas with wider beamwidth are more tolerant to sway and smaller antennas present a smaller wind-load (less aggravating to the sway problem. Half diameter makes ¼ of the cross -sectional area for wind loading).

E-band technology evolution



38dBi gain

5G paths envisioned as short paths requiring less antenna gain. Smaller antennas also have the following advantages:

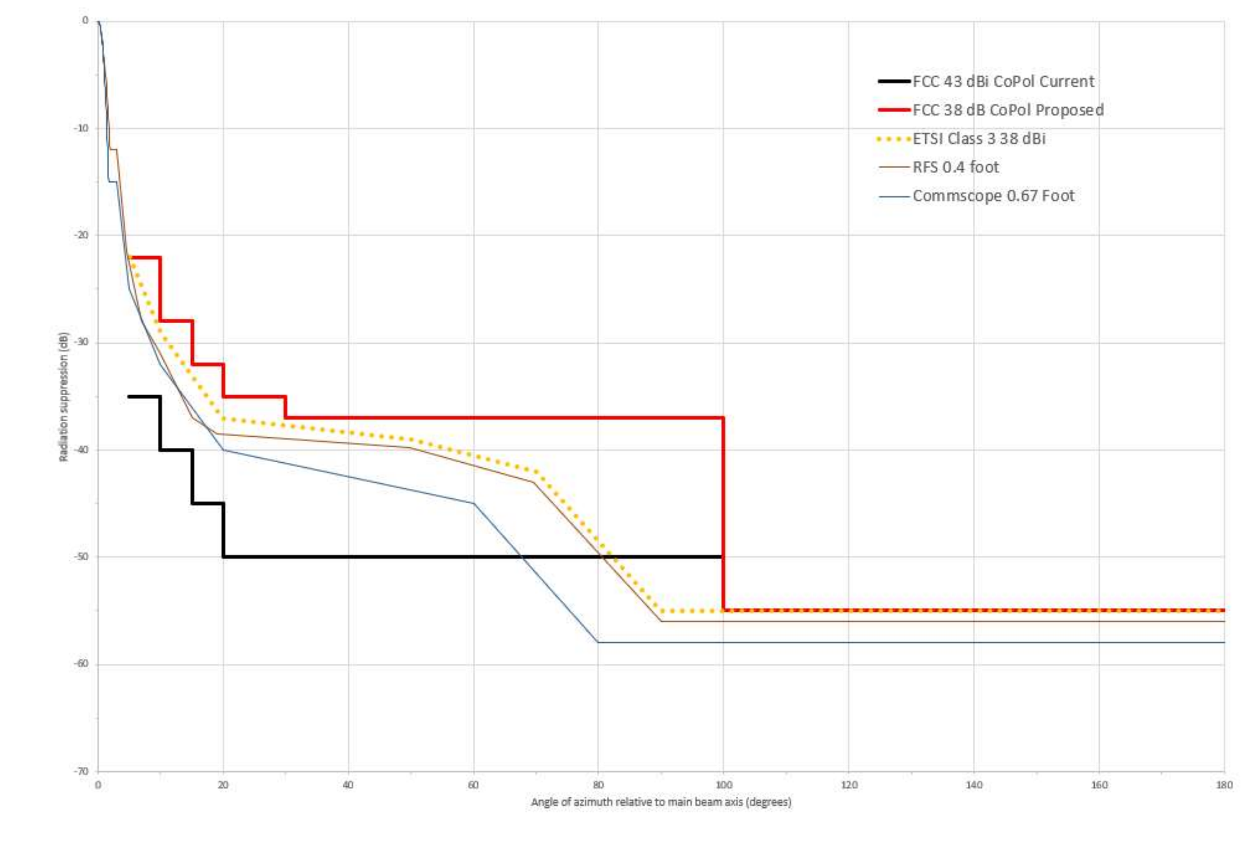
1) Reduce visual impact
2) Ease installation on street-level mounting surfaces
3) Reduce site cost
4) Better withstand sway

Proposed Rule Change to Permit Smaller Antennas: Antenna Gain

Current FCC Rule vs. Proposed Revision

Graph and table (on next page) adapts ETSI specification to the FCC table in Section 101.115

Mask relaxation allows for smaller 0.5 foot antennas and will be compatible with ETSI Class 3 antennas for a greater antenna selection



Proposed rule change
Antenna pattern

We Propose:

- Smaller antennas for fixed point-to-point operations
- Modify 101.115 to replace the current entries for the band as in this table (table adapts ETSI specification to be consistent with this FCC rule section)
- 38dBi as minimum antenna gain in E-band
- Remove co-polar discrimination requirement in footnote 14 applicable from 1.2° to 5°
- All other rules unchanged, like the proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of antenna gain. Max EIRP will be 31 dBW at gain of 38 dBi

Frequency (MHz)	Category	Maximum beamwidth to 3 dB points[1] (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibels						
				5° to10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (co-polar) current	N/A	1.2	43	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar) current	N/A	1.2	43	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar) current	N/A	1.2	43	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar) current	N/A	1.2	43	45	50	50	55	55	55	55
71,000 to 76,000 (co-polar) Proposed	N/A	2.2	38	22	28	32	35	37	55	55
71,000 to 76,000 (cross-polar) Proposed	N/A	2.2	38	35	35	40	42	47	55	55
81,000 to 86,000 (co-polar) Proposed	N/A	2.2	38	22	28	32	35	37	55	55
81,000 to 86,000 (cross-polar) Proposed	N/A	2.2	38	35	35	40	42	47	55	55

Black shows current specs, red shows proposed spec

Harmonization with Other Countries

Canadian SRSP 371.0 for 71-76 GHz and 81-86 GHz allows 38 dBi antennas. There are two masks: Envelope A, a more restrictive mask for more congested areas and any channel bandwidth; and Envelope B, a less-restrictive mask for areas with less congestion and bandwidths less than 2 GHz. Envelope A is exactly identical to ETSI Class 3 at 38 dBi and Envelope B is exactly identical to ETSI Class 2 at 38 dBi. In this way, the antenna selection available in Europe is available to Canada.

Revised proposed masks for FCC would allow the same ETSI Class 3 antennas to be used in the US, offering a broader selection of available antennas and creating a common market for the US, Europe and Canada.

No Additional Rule Change Required to Manage Interference

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Example – Typical Urban Deployment Scenario

An urban scenario in Manhattan, New York:

- 17 small cells situated at street level, on cross-roads to increase penetration at street level
- Distance between cells: 150m – 650m
- RAN technology: 5G mmWave
- Each cell generates 5Gbps peak traffic
- Fiber optic point: FO (red site)
- Last mile midhaul/backhaul: E-Band links with 38dBi antennas

Example – Typical Urban Deployment Scenario

E-Band links:

- Path length: 150m to 650m
- Link configuration: 1+0/1000MHz
- Antennas: 38dBi integrated antennas
- Traffic aggregation methodology: according to NGMN methodology

Aggregation - Scenario1

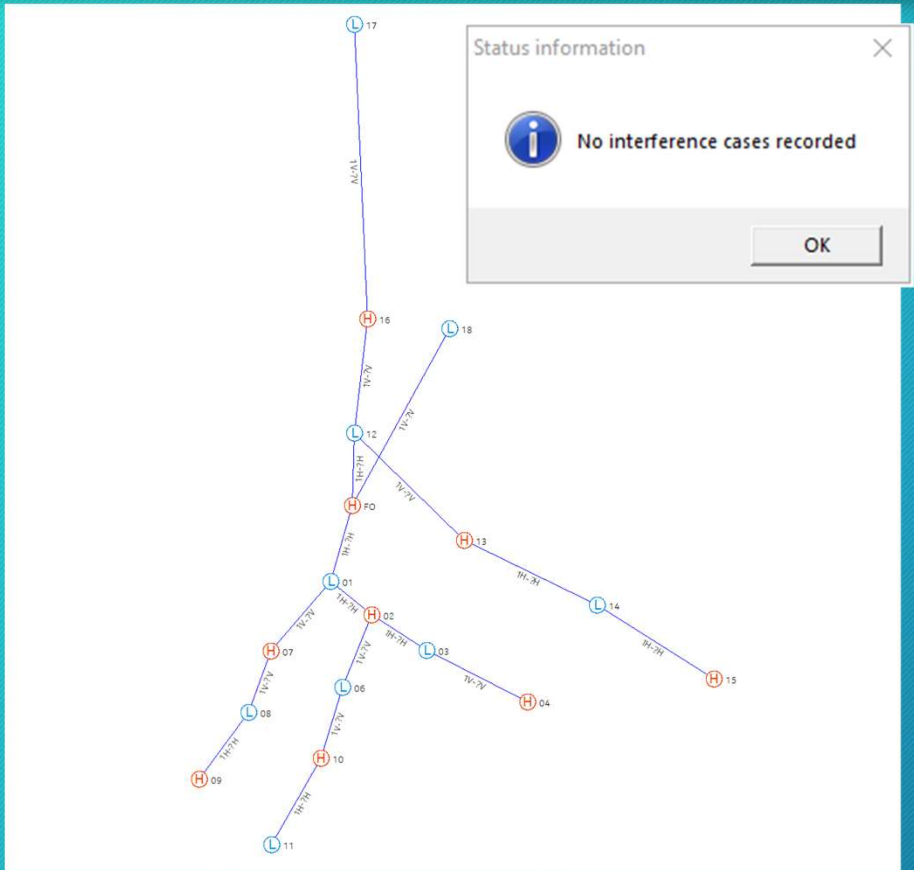
Computation | Advanced

Aggregation computation: Engineering margin per flows

Specific Computation for Negative Factor

Hub level	Boundary Points	# of flows	EF/CBR factor	AF3/rtVBR factor	AF1/nrtVBR factor	BE/UBR factor	Min bw check
Hub Level 1 (No aggre...	Point1	1	100.0	100.0	100.0	100.0	
Hub Level 2 (From Poi...	Point2	2	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 3 (From Poi...	Point3	5	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 4 (From Poi...	Point4	10	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 5 (From Poi...	Point5	20	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 6 (From Poi...	Point6	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 7 (From Poi...	Point7	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 8 (From Poi...	Point8	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 9 (From Poi...	Point9	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 10 (From Poi...	Point10	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 11 (From Poi...	Point11	30	0.0	0.0	0.0	0.0	Max peak flows
Hub Level 12 (From Poi...	Point12	30	0.0	0.0	0.0	0.0	Max peak flows
General case	Point13	∞	0.0	0.0	0.0	0.0	Max peak flows
Verification		1	100.0	100.0	100.0	100.0	

Example – Typical Urban Deployment Scenario
Frequency planning & interference evaluation

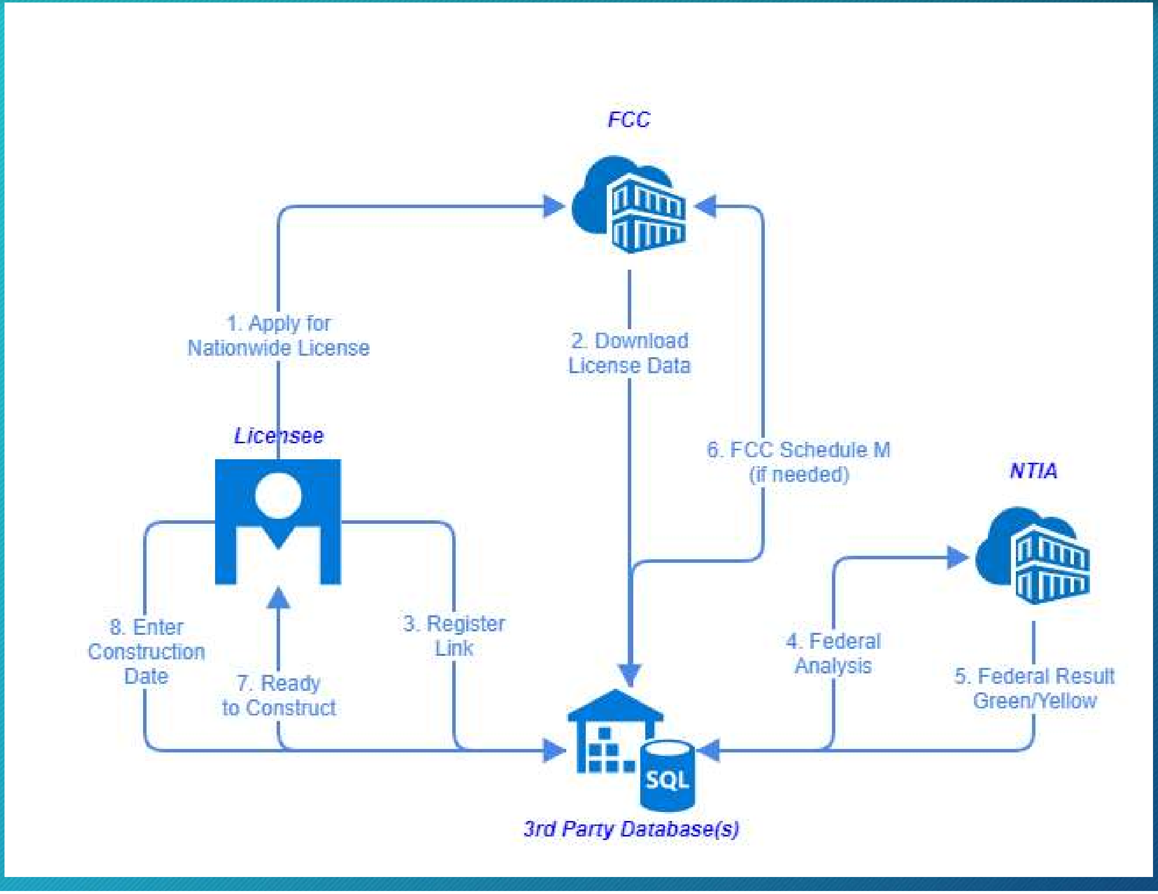


A full detailed link design has been performed, including the frequency planning and interference evaluation.

Using only 1 channel of 1000MHz (73500MHz – 83500MHz), both H and V polarizations and ATPC, **no interference cases were recorded**

Antenna RPE as per proposal with 38dBi Gain

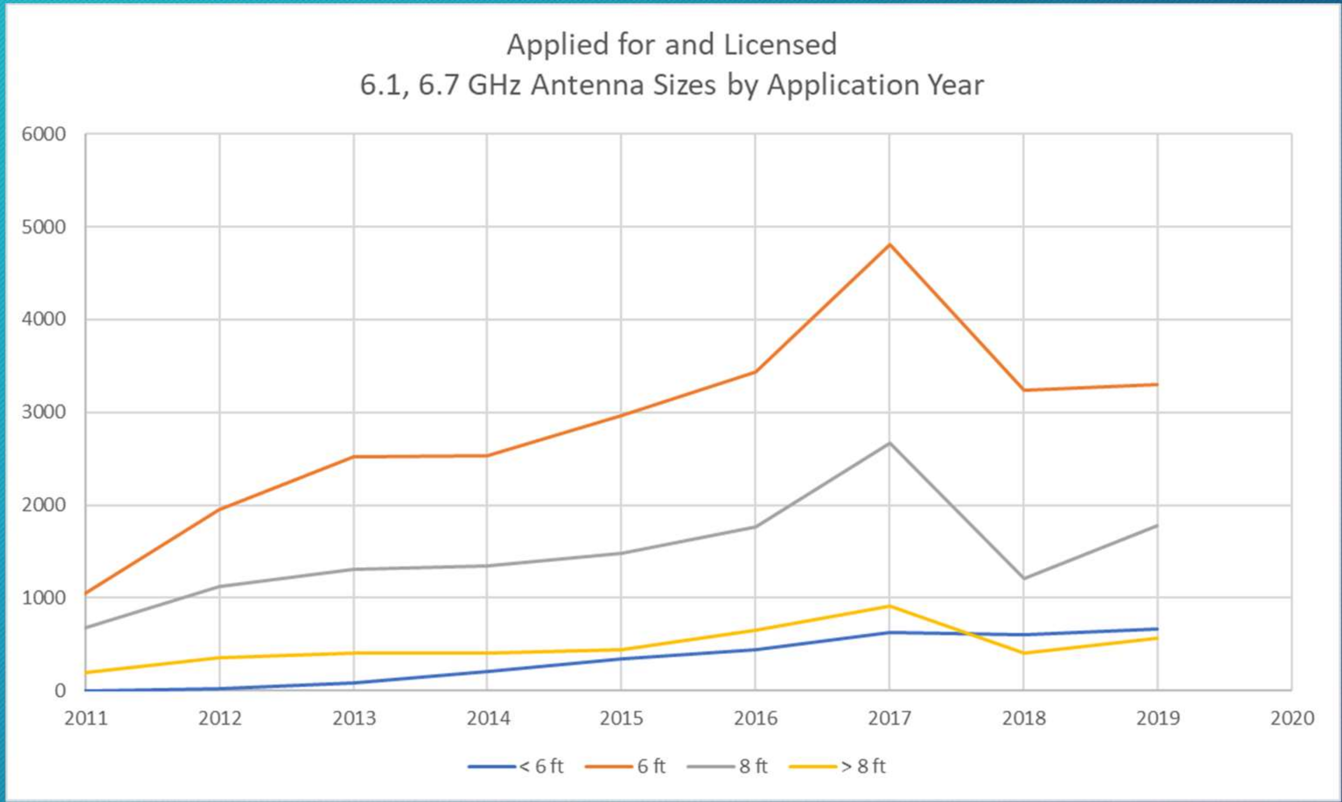
Existing Third Party Coordination Process Sufficient to Manage Interference



Similar rule changes successful in other bands

In other frequency bands:

- Smaller antennas improved flexible use of the band.
- Deployment of larger antenna continued to grow despite use of wider beamwidth antennas.



Additional Rule Change (Desired but not Required): Improve Registration and Certification

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Proposed improvements:

- Require construction certifications by the end of the construction period.
- At renewal time, require the identification of registrations that are beyond the construction period and construction certifications for those that are built and in operation.
- Cancel and delete from the database those registrations that remain unbuilt beyond the construction period.

Conclusions and Next Steps

Conclusions and Next Steps

- Operators need solutions to make existing networks evolve to support 5G
- Not all cell sites are served by fiber (especially at street level with 5G mmWave and small cells), but uWave/mmWave transport technology and especially E-band 70/80 GHz have evolved to provide the necessary KPIs
- Amendments to antenna gain rules on E-band backhaul would enable new scenarios linked to 5G densification at street level (38dBi antennas need to be allowed)
- Next steps: We ask WTB to seek expedited comment on this discrete proposal to allow 38 dBi antennas in the E-Band, already widely used globally, and that the Commission adopt this proposal without further delay

THANK YOU!